...ood For Plants.

HARRIS

WHEN VISITING THE WORLD'S FAIR, see the Nitrate Exhibits in the following places:

AGRICULTURAL BUILDING, Section F, North Gallery.

MINES AND MINING BUILDING, Chilean Exhibit, South-West corner.

MIDWAY PLAISANCE, Nursery Section, Showing the effect of Nitrate of Soda on growing plants.

CONTENTS.

FOOD FOR PLANTS.

[*From the writings of Joseph Harris, M. S. Edited and revised by S. M. Harris.*]

It is well known that animals, and especially young animals, must have all the food they can eat in order to properly develop and grow fat. This is equally true of plants. Plants will manage to live on very little food, but to grow, thrive and bear fruit they require an abundance of food in the soil.

The food of plants consists of a number of elements, including Nitrogen, Phosphorus (in the form of phosphoric acid), Lime, Magnesia, Iron, Silica, Potash, etc. A sufficient quantity of all these necessary elements, except Nitrogen, Phosphoric Acid and Potash, exists in nearly all agricultural soils. Nitrogen is nearly always deficient, Phosphoric Acid usually, and Potash often. In some soils there may be enough of all the elements of plant food except one. Let us assume that this one is Nitrogen. In this case the growth and yield of the crop will be limited by the quantity of *Nitrogen* it can obtain. There might be an abundant supply of all the other elements, but the plants could not use them without Nitrogen. This would be true of any one of the other elements that might be deficient. The plants must have them *all* at the same time to develop in perfection.

What the farmer and gardener must do therefore *is to furnish the plants with the elements of plant-food that are lacking in the soil.*

Nitrogen is the one that is nearly always deficient. This is due to the fact that Nitrogen in a soluble form is easily washed out of the soil, while Phosphoric Acid, Potash and the other mineral elements will not wash out.

The question that presents itself to the farmer, gardener, and fruit grower, is, *How can I supply my plants with Nitrogen, Phosphoric Acid and Potash, in the best forms and at the least expense?* We will try to throw some light upon this question in the following pages. We will take first,

PHOSPHORIC ACID.

There are two principal sources of phosphoric acid, namely, bones and rock phosphates. Of these the rock phosphate is the cheapest source. A prevailing impression exists that superphosphate made from rock phosphate is not as good as that made from bones. It has been shown by many experiments that this idea is entirely without foundation. What the plants want is *soluble* phosphoric acid, and it makes little or no difference from what source it is derived.

The largest deposits of rock phosphate exist in South Carolina and Florida. These beds of phosphate are supposed to be composed of the petrified bones and excrements of extinct animals. When this substance is ground and mixed with a sufficient quantity of sulphuric acid, the larger part of the phosphoric acid which it contains becomes soluble in water. The knowledge of this fact was one of the greatest agricultural discoveries of the age.

When the rock phosphate is thus treated with sulphuric acid, it becomes what is chemically known as Superphosphate of Lime. The same is true if ground bone is treated in the same way. A good sample of Superphosphate contains 14 per cent. of soluble phosphoric acid.

POTASH.

The cheapest sources of potash are Muriate of Potash (or as it is more properly called, Chloride of Potassium) and wood ashes.

Wood Ashes, if unleached, contain from 3 to 5 per cent.

of potash in the form of carbonate of potash. They also contain from 1 to 2½ per cent. of phosphoric acid (insoluble). They are worth, as plant food, from $7.00 to $12.00 per ton, according to the amount of potash and phosphoric acid they contain.

Muriate of Potash is by far the most important source of potash. It is found in large deposits near Stassfort, Germany, in what is called "Carnallite," which contains about 15 per cent. of muriate of potash. This is refined so that when exported the commercial article contains from 80 to 85 per cent. of pure muriate of potash, or 50 to 52 per cent. of actual potash. This is the cheapest form in which potash can now be bought.

Sulphate of Potash. It is claimed that a few plants, of which tobacco is the most important, are injured by the chlorine contained in the muriate of potash; sulphate of potash is therefore used for these crops. It is made by the action of sulphuric acid upon muriate of potash.

NITROGEN.

Nitrogen is the most expensive, important and effective element of plant-food, and at the same time is the one that is generally deficient in the soil.

There are a great many sources of nitrogen, such as sulphate of ammonia, which is obtained during the process of making gas, dry ground fish, cotton-seed meal, dried blood, leather scraps, etc. But none of these furnish nitrogen in the form in which it is taken up by plants, namely, *nitric acid*. This can only be furnished to plants in the form of nitrates. Nitrogen applied in any other form has to be converted into nitrate before it can be taken up by the plants.

A nitrate is the result of a union between nitric acid and an element called a "base." Nitric acid contains the *nitrogen* that is necessary for the growth of plants. It

unites with many different elements, and forms a number of salts that are useful for many purposes. For instance, when united with potash it forms nitrate of potash, or what is commonly called "nitre" or "saltpetre;" when united with soda it forms nitrate of soda, which is the best form in which to furnish nitrogen to plants. When we say the *best* form we mean the best *practical* form. Nitrate of potash (saltpetre) would be just as good, but is much too expensive. Nitrate of soda not only furnishes nitrogen in its most available form, but it furnishes it at a lower price than almost any other source. The exceptions are a few organic substances in which nitrogen exists in an insoluble form.

Nitrate of soda is found in vast quantities in the north of Chile, South America. The beds of nitrate, or "Caliche" as it is called in Chile before it is refined, are several thousand feet above the sea, on a desert plain extending for seventy-five miles north and south, and about twenty miles wide, is a rainless region. The surface of the desert is covered with earth or rock, called "costra," which varies from three to ten or more feet in thickness. Under this is found the "caliche," or crude nitrate. The layer of "caliche" is sometimes eight or ten feet thick, but averages about three feet. This "caliche" contains on the average about 50 per cent. of pure nitrate of soda.

The "caliche" is refined by boiling in water to dissolve the nitrate. The hot water is then run off and allowed to cool in tanks, when the nitrate forms in crystals like common salt. The nitrate is then placed in bags of about three hundred pounds each and shipped to all parts of the world. Nitrate of soda, as exported, contains about 15½ per cent. of nitrogen. The export of nitrate of soda from Chile, in the year 1890, amounted to over a *million tons* of 2,240 lbs. each. By far the largest part of this went to Europe, for use as a fertilizer. How these beds of nitrate were formed has been the subject of much speculation. The generally-accepted theory is, that they were formed by the gradual

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as asparagus, however, doubling the yield ate of soda does not tell half the story. sold by the bunch, weighing about 2½ rices range, according to earliness and cents to 25 cents per bunch at wholesale, 200 per ton.

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Nitrate of Soda, $100 per acre.
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decomposition and nitrification of marine animal and vegetable matter, containing a considerable amount of nitrogen.

The same wise Providence that stored up the coal in the mountains of Pennsylvania to furnish fuel for the people of the United States when their supply of wood had become exhausted, preserved this vast quantity of nitrate of soda in the rainless region of Chile, to be used by the people of the nineteenth century to furnish their crops with the necessary nitrogen, when the natural supply in the soil had become deficient.

"COMPLETE FERTILIZERS."

AN EXPENSIVE WAY TO BUY PLANT FOOD.

By "complete fertilizers" we mean fertilizers containing nitrogen, phosphoric acid and potash. This includes the majority of the fertilizers sold. These fertilizers are commonly called "Phosphates." People have fallen into the habit of calling any commercial fertilizer a "Phosphate," whether it contains any phosphate or not.

Bearing in mind that all that is of any value in these "Phosphates," no matter how high-sounding their names, is nitrogen, phosphoric acid, and potash, let us see what they are really worth—that is, what the same amount of plant food can be bought for in our markets, in just as good, if not better, forms.

The New Jersey Experiment Station analyzed 195 different samples of brands of "Complete Fertilizers," and published the results in Bulletin No. 89, October 10th, 1892. It was found that, in some instances, complete fertilizers that sold for $34.00 to $36.00 per ton only contained plant food worth $15.00 to $17.00! But they were not all as bad as this. The *average* of all brands analyzed was as follows: They contained 2.74 per cent.

Nitrogen, 7.70 per cent. available Phosphoric Acid, and 4.50 per cent. Potash. The selling price was $34.23 per ton and the actual agricultural value $25.66 per ton. By this is meant that the same amount of actual plant food that is contained in the "complete fertilizers," costing $34.23, could be purchased in the open market, in just as good forms, for $25.66. As a matter of fact, it could be purchased for much less than this in quantities of ten tons or more. In one ton of the above "average fertilizer," selling for $34.23, there is 154 pounds available phosphoric acid, which can be bought for 5¼ cents per pound in superphosphate or "acid phosphate," as it is called by the trade. This 154 lbs. of phosphoric acid is therefore worth $8.09. There is 54 4-5 pounds nitrogen, which can be bought in nitrate of soda for 15 cents per pound, making it worth $8.22; 90 pounds potash, worth 4½ cents per pound, equals $4.05, making in all $20.36 for the plant-food contained in a ton costing $34.23.

But this does not tell the whole story. The nitrogen contained in these "complete fertilizers" is often in a form that is not available to the plants until it has undergone decomposition in the soil and become converted into nitrate. The time required to do this varies from a few days to years, according to the temperature of the soil and the material used to furnish nitrogen. In calculating the value of Complete Fertilizers, nitrogen in the form of sulphate of ammonia, which has to be converted into nitrate before it is available, is reckoned at 2 cents per pound higher than it can be bought in the form of nitrate of soda. This is not because the nitrogen in sulphate of ammonia is any better than in nitrate of soda, but because it *costs more.* This makes the fertilizers appear to be worth more than they really are. But taking the figures as they are given, it is readily seen that the consumer of these complete fertilizers pays on the average $8.57 per ton more than would buy the same amount of plant-food in as good,

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chemicals.

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Statistics gathered by the stations show that over *one million dollars* was spent in 1891 in the State of New Jersey alone for "complete fertilizers." Considering that the average "complete fertilizer" costs 25 per cent. more than it is worth, it is evident that the farmers of New Jersey paid \$250,000 more for their fertilizers than they got value in return. And this state of things is not confined to the State of New Jersey. It is the same all over the country. The farmers of this country are paying out millions of dollars annually to the manufacturers of "complete fertilizers" which they could very easily save by the exercise of a little intelligence in buying their plant-food.

HOW TO SAVE MONEY ON FERTILIZERS.

Would you not think a man very "green" who should buy somebody's "Complete Prepared Food," at a high price, when he wanted feed for his horses, instead of going into the market and buying corn, oats, and hay, at market prices? The "Complete Prepared Food" would probably be composed of corn, oats and hay mixed together, and the price would be perhaps twice as much as the corn, oats, and hay would cost separately. It is the same with plant-food. You should buy your plant-food in the best and cheapest forms, and feed it to the plants separately or mixed together as you prefer. You can buy available nitrogen in nitrate of soda for less than 15 cents per pound. In complete fertilizers, or what are usually called "Phosphates," nitrogen costs from 20 to 30 cents per pound, and even then, it is often in an insoluble and unavailable form.

Nitrate of Soda is at the present time the cheapest and best form in which to buy available nitrogen.

You can buy soluble Phosphoric Acid, in Superphosphate of Lime made from rock phosphate, for about 6 cents per

pound (the superphosphate costing from $15 to $17 per ton, retail), or in bone black, which is made from bones that have been used during the process of refining sugar, for about 7 cents per pound. These are, I think, at present, the two cheapest sources of soluble Phosphoric Acid.

Potash can be bought, in Muriate of Potash, for about 4½ cents per pound. This is the cheapest source of potash.

Let us see what a "*High Grade* Complete Fertilizer" made from these three sources of plant-food would cost.

600 pounds Nitrate of Soda, containing 46 pounds Nitrogen, costs	$13 50
1,100 pounds Superphosphate, containing 150 pounds Phosphoric Acid, costs	8 25
300 pounds Muriate of Potash, containing 150 pounds Potash, costs	6 75
2,000 pounds, or one ton, costs	$28 50

This fertilizer would contain Nitrogen 5 per cent., (equal to over 6 per cent. of Ammonia,) Phosphoric Acid 7¾ per cent., and Potash 7¾ per cent.

A "Complete Fertilizer," containing as high a percentage of Nitrogen, Phosphoric Acid and Potash as the above mixture, would cost at least $35.00, and nine manufacturers out of ten would charge $45.00 for it; and even then the Nitrogen would not be in a form in which it would be immediately available.

If a fertilizer is wanted that contains no more Nitrogen than the majority of the complete fertilizers or "Phosphates" sold for $28.00 per ton, it could be made for about $22.00 per ton.

AMMONIA AND NITROGEN.

The manufacturers of fertilizers usually guarantee their fertilizers to contain a certain percentage of Ammonia instead of Nitrogen. They do this probably because the amount sounds larger when expressed in Ammonia than in

Nitrogen. Ammonia is a compound o
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1885
1886
1887
1888
1889
1890

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Are the Farmers of England and Europe More Intelligent Than Their American Cousins?

It certainly seems so. The English and European farmers instead of buying their nitrogen in complete fertilizers and paying over 20 cents per pound for it, used during the year 1890 over eight hundred thousand (800,000) tons of nitrate of soda as a fertilizer, while not ten thousand tons were used as a fertilizer in America. The demand for nitrate of soda in Europe has steadily increased as shown by the following table:

Exports of nitrate of soda from Chile during the six years ending December 31, 1890:

	Tons of 2,240 lbs.
1885..............................	425,000
1886..............................	440,000
1887..............................	700,000
1888..............................	750,000
1889..............................	930,000
1890..............................	1,050,000

American farmers, gardeners and fruit growers are supposed to be ready to "catch on" to a good thing. And as soon as our agricultural papers let them know the facts in regard to the great value of nitrate of soda as a fertilizer our farmers will not be slow to use it. The reason why so little is said about nitrate of soda, is simply owing to the fact that there is "no money in the trade." It is an article that everybody can sell and consequently no one can afford to advertise it. The manufacturers of "complete fertilizers" pay the agricultural papers large sums of money every year for advertising, and consequently the editors do not like to publish anything that might injure this trade. The real friends of agriculture, however, will be pleased to know that there was a decided increase in the demand for nitrate of

soda in this country the past spring. As soon as the farmers demand it, the importers and dealers in fertilizers will be glad to keep the nitrate for sale, and sooner or later will advertise it. In the meantime, if your agricultural paper does not tell you about nitrate of soda and how to use it, take a paper that keeps up with the science and practice of the age.

FERTILIZERS FOR WHEAT.

The Royal Agricultural Society of England have conducted experiments with fertilizers on wheat for over 20 years on the same land on the Duke of Bedford's estate at Woburn. The results are shown in the following table:

Description of Manures.	Yield per Acre of Wheat in Bush.							
	1881	1882	1883	1884	1885	1886	1887	1888
1. No Manure.............	25	13	16	23	21	13	22	11
2. Mineral Manures, (Superphosphate and Potash)..	28	15	17	22	22	15	18	11
3. Same as No. 2 and 275 lbs. Nitrate of Soda....	45	33	38	43	39	31	40	31

It should not be forgotten that these are the results with nitrate of soda on wheat grown year after year continuously on the same land. In such conditions, unquestionably more or less nitrogen is lost, and consequently we do not get as profitable results from its use as in ordinary rotation on a well-managed and properly cultivated farm. One thing is absolutely proved, however, and that is that wheat must have nitrogen.

THE BEST FORM OF NITROGEN FOR WHEAT.

Some interesting experiments were conducted by Prof. H. A. Huston, at the Purdue University Agricultural Experiment Station, at Lafayette, Indiana, during the season of 1890-91, to determine the best form of nitrogen

for wheat. We quote what Professor Hu
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"The forms of nitrogen selected were nitrate of soda, azotine or dried blood, and sulphate of ammonia. The main object was a comparison of nitrate of soda with dried blood, and the sulphate of ammonia was introduced into the series for comparative purposes. The forms of nitrogen used in nearly all commercial fertilizers are dried blood and the nitrogen of organic compounds like bone meal or cotton-seed meal.

It is well established that nitrate of soda is superior to sulphate of ammonia for wheat, but comparatively little seems to be known of the relative merits of nitrate of soda and organic nitrogen. The present price of ammonia salts is such that they are not generally used in compounding fertilizers, and it so happens that the nitrogen of organic compounds is used in the so-called "ammoniated" fertilizers. Nitrate of Soda furnishes more nitrogen for the same money, but it is very difficult to keep a mixture of super-phosphate and nitrate of soda."

Here follows a table of the results, which we have not room to give. Professor Huston goes on to say:

"It will be noticed that the nitrate of soda gave by far the best results, the gain being nearly double that for the organic nitrogen, and about one-half more than that for the ammonia compounds. There appears on the whole no advantage from the use of fractional applications, while in the case of the ammonia compound there was a decided loss in fractional applications."

The results of changing the form of the nitrogen at different stages of the growth of the plants are given in Table II. We have not room to reproduce this table, but Professor Huston's remarks which follow give the practical result:

"Here the nitrate of soda seems to be the controlling factor, and, so far as the appearance of the plants indicated, there was no advantage from change of form. All the plants in this series to which nitrogen was applied looked practically alike from the beginning to the end of the experiment. No appreciable difference could be seen in the fall, or at the opening of spring up to April 10-15, between the plats to which nitrogen had been applied and those which had received no nitrogen. On April 20th the plats to which nitrogen had been applied showed a darker color and the plants were larger with broader leaves. From this time on the nitrate of soda plats seemed to lead the others. On May 18th

the ground was too dry for the wheat to make much growth, but the rain of May 20-21 was very seasonable, and the nitrogen applied on May 18th was washed into the ground. At this time the nitrate plats seemed better than those having sulphate of ammonia, and both the nitrate and ammonia plats were heavier and of much darker color than those receiving azotine. The plants on the plats that had received nitrogen were about six inches taller than on those receiving no nitrogen, and this continued until the grain was ripe."

SUMMARY.

"1. The experiment confirms the superiority of nitrate of soda over ammonia salts for wheat, and indicates that its superiority over organic nitrogen is even greater than that over ammonia salts

2. A given sum of money will buy more nitrogen in the form of nitrate of soda than in any other form except cotton-seed meal, *yet the gain from nitrate of soda is nearly double that from the use of organic nitrogen.*"

Professor Atwater in writing of some experiments made by Professor McBride at the South Carolina Agricultural Experiment Station, on oats and wheat, in 1889, says:

"A comparison of four of the tests conducted on both farms indicates that the inorganic nitrogen (nitrate of soda) gave nearly 100 per cent. more increase of yield than the organic (*cotton seed meal, dried blood, etc.*,) and nearly 50 per cent. more than both forms used together.

HOW TO APPLY NITRATE OF SODA TO WHEAT.

Drill in with the wheat in the fall a mixture of 250 pounds superphosphate and 50 pounds nitrate of soda per acre Or, if your land is sandy and poor, add 50 pounds muriate of potash to the above. Early in the spring, sow broadcast 100 pounds nitrate of soda per acre A larger quantity of nitrate would undoubtedly increase the yield of wheat, but might not pay as well as the smaller application. If wheat was worth $1.50 per bushel, it would pay well to use more nitrate.

Prof. W. F. Massey wrote to Mr. H. J. Scott of Virginia, in regard to the effect of nitrate of soda on wheat, as follows:

"I have made several experiments with nitrate
on wheat in Albemarle county, Va. I used 200 p
of a field which had been fertilized with 400 pour
the fall. The result was 9 bushels per acre more
field, and a stand of clover, while none of any acc
of the field."

A smaller application of nitrate possib
duced nearly as good results.

FERTILIZERS FOR BA

At the celebrated Experimental Farm
at Rothamsted, England, in 1883, the fol
obtained by the use of superphosphate
on barley:

No manure...
3½ cwt. superphosphate of lime ....
3½ cwt. superphosphate of lime and 200 lbs. ar
monia salts............... ....
3½ cwt. superphosphate of lime and 275 lbs. N
trate of Soda..........................

The 200 pounds of ammonia salts
nitrogen as the 275 pounds nitrate of so
produced nearly 4 bushels more barl
evident from the above that barley must
that it is more effective in the form of
form of ammonia.

In the experiment made by Dr. Voelc
Royal Agricultural Society of England
lowing results were obtained with barl
year on the same land:

DESCRIPTION OF MANURES.	YIELD PER ACRE OF DR				
	1880	1881	1882	1883	1S
No Manure.	21	33	27½	22¾	[illegible]
Mineral Manures........	22⅓	33½	23	28	[illegible]
Mineral Manures and 275 lbs Nitrate of Soda....	49	53	50½	55¾	[illegible]

"I have made several experiments with nitrate of soda. The first was on wheat in Albemarle county, Va. I used 200 pounds per acre on part of a field which had been fertilized with 400 pounds acid phosphate in the fall. The result was 9 bushels per acre more than on the rest of the field, and a stand of clover, while none of any account stood on the rest of the field."

A smaller application of nitrate possibly would have produced nearly as good results.

FERTILIZERS FOR BARLEY.

At the celebrated Experimental Farm of Lawes & Gilbert at Rothamsted, England, in 1883, the following results were obtained by the use of superphosphate and nitrate of soda on barley:

No manure	16¼	bushels per acre
3½ cwt. superphosphate of lime	22⅜	" "
3½ cwt. superphosphate of lime and 200 lbs. ammonia salts	49½	" "
3½ cwt. superphosphate of lime and 275 lbs. Nitrate of Soda	53¼	" "

The 200 pounds of ammonia salts contained as much nitrogen as the 275 pounds nitrate of soda, but the nitrate produced nearly 4 bushels more barley per acre. It is evident from the above that barley must have nitrogen, and that it is more effective in the form of nitrate than in the form of ammonia.

In the experiment made by Dr. Voelcker in behalf of the Royal Agricultural Society of England at Woburn, the following results were obtained with barley sown year after year on the same land:

DESCRIPTION OF MANURES.	YIELD PER ACRE OF DRESSED BARLEY IN BUSH.								
	1880	1881	1882	1883	1884	1885	1886	1887	1888
No Manure	21	33	27½	22¾	33¼	22½	18¼	20¼	16½
Mineral Manures	22⅓	33½	23	28	32	21	18¾	22	20
Mineral Manures and 275 lbs Nitrate of Soda	49	53	50½	55¾	57¾	50¼	40¼	43½	45½

The mineral manures consisted of superphosphate and potash. We would recommend drilling in with the barley a mixture of 200 lbs. superphosphate and 150 lbs. nitrate of soda per acre, and, if the land is "run down" or sandy, add 50 to 100 lbs. muriate of potash to the mixture.

FERTILIZERS FOR OATS.

We recommend the use of the same mixture for oats as for barley.

In 1888 we used 200 pounds superphosphate and 150 pounds nitrate of soda on 7¼ acres of oats, and harvested 610 measured bushels. The oats weighed 40 pounds per bushel, and we therefore got over 100 bushels of 32 pounds per acre. The land was sown to wheat in the fall and seeded down with timothy and clover. The wheat was a heavy crop, and the crop of hay the following year was immense.

FERTILIZERS FOR POTATOES.

There is more profit to be derived from the use of fertilizers on potatoes than on almost any other farm crop. Potatoes are largely water. A bushel of potatoes contains only about 12 pounds of dry matter. Yet a bushel of potatoes is often worth as much as a bushel of wheat. A given amount of plant-food is capable of producing almost four times as many bushels of potatoes as of wheat. If a good price is obtained for the potatoes the profits from the use of fertilizers are often very large.

In 1891 the New Jersey Experiment Station conducted some experiments with potatoes on the farm of Mr. Amos Gardener in Gloucester county, N. J. The potatoes were planted in plots of one-twentieth of an acre. The results are given in the following table :

EXPERIMENTS WITH FERTILIZERS ON

Kind of Fertilizer Used.	Yield per Plo	
	Large.	Small
1. No Manure	143	57
2. Bone Black (superphosphate) 16 lbs.; Muriate of Potash, 8 lbs.	321	51
3. Same as above with Nitrate of Soda, 10 lbs	562	40
4. Barn-yard Manure, 1 ton	432	65

It will be noticed that on plot 3, where
the yield was not only greatly increased b
of small potatoes was very much less th
plots. The addition of nitrate of soda, at
pounds per acre, to the superphosphate and
increase of 80 bushels of large potatoes pe
pounds of nitrate cost about $4.75. The v
of potatoes at 60 cents per bushel would
profits can be easily calculated. It
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large potatoes more per acre than
manure.

In speaking of these experiments, P
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TILIZERS FOR OATS.

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EXPERIMENTS WITH FERTILIZERS ON POTATOES.

Kind of Fertilizer Used.	Yield per Plot in lbs.			Yield per Acre in Bushels.
	Large.	Small.	Total.	
1. No Manure	143	57	200	33⅓
2. Bone Black (superphosphate) 16 lbs.; Muriate of Potash, 8 lbs.	321	51	372	124
3. Same as above with Nitrate of Soda, 10 lbs	562	40	602	200¾
4. Barn-yard Manure, 1 ton	432	65	497	165¾

It will be noticed that on plot 3, where nitrate was used, the yield was not only greatly increased but the percentage of small potatoes was very much less than on the other plots. The addition of nitrate of soda, at the rate of 200 pounds per acre, to the superphosphate and potash made an *increase* of 80 bushels of large potatoes per acre. The 200 pounds of nitrate cost about $4.75. The value of 80 bushels of potatoes at 60 cents per bushel would be $48.00. The profits can be easily calculated. It is also worthy of note that the chemical fertilizers produced 43 bushels of large potatoes more per acre than 20 tons of barn-yard manure.

In speaking of these experiments, Prof. Voorhees says :

"The usefulness of field experiments is clearly brought out, for it is distinctly shown by this work that land which will produce but 50 bushels of poor quality of potatoes without manure, and which brings barely paying crops with barn-yard manure, by the judicious use of chemical manures may become fairly profitable, even in a season of low prices."

A small crop of potatoes is never profitable. The cost of growing a poor crop is nearly as great as that of growing a large one. The cost of labor and rent of land is at least $30 per acre. The man who only gets 50 bushels per acre loses money on his crop unless the price is extraordinarily high.

In the experiment quoted above, the land was so poor that without manure only 33 bushels per acre were obtained. But by the use of $12.34 worth of fertilizers 200 bushels were raised. Where this yield was obtained the quantity of

fertilizer used was as follows: 200 pounds nitrate of soda, 320 pounds bone black (superphosphate), and 160 pounds muriate of potash. These were mixed together and scattered along the rows before the potatoes were planted. On richer land, the same amount of fertilizers would undoubtedly have produced a much larger crop.

Mr. E. S. Carman, editor of the *Rural New Yorker*, experimented with fertilizers on potatoes on rich land with the following results:

1.—400 pounds superphosphate and 300 pounds sulphate of potash—245 bushels per acre.

2.—Same as plot 1 with the addition of 200 pounds nitrate of soda—348 bushels per acre.

It is evident from the fact that the addition of 200 pounds of nitrate of soda produced 103 bushels more than the superphosphate and potash alone, that potatoes must have nitrogen, and that, in greater quantities than is supplied by the ordinary "Phosphate" or "Complete Potato Manure."

FERTILIZERS FOR SWEET POTATOES.

It is the usual practice among sweet potato growers to use large quantities of stable manure for this crop. In 1891 the New Jersey Experiment Station made some experiments in order to determine whether commercial fertilizers could not be used instead of stable manure, which is a large item of expense. The experiment was conducted on the farm of Mr. Theodore Brown, in Gloucester county, New Jersey. The following table gives the most important results:

EXPERIMENT WITH FERTILIZERS ON SWE

Kind of Fertilizer and Quantity per Acre.	Cost of Fertilizer.
1. No Manure	
2. 320 lbs. Bone Black, 160 lbs. Muriate of Potash	$7.70
3. 200 lbs. Nitrate of Soda, 320 lbs. Bone Black, 160 lbs. Muriate of Potash	12.34
4. 20 tons Barn-yard Manure	30.00

It will be seen that the addition of n
the bone black and potash gave an increa
per acre, and that the nitrate, bone bla
together costing $12.34, produced a little
20 tons of manure, costing $30.00. In
results, Prof. Voorhees says:

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FERTILIZERS FOR TOB

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EXPERIMENT WITH FERTILIZERS ON SWEET POTATOES.

Kind of Fertilizer and Quantity per Acre.	Cost of Fertilizer.	Bushels per Acre.		
		Large.	Small	Total.
1. No Manure....................		157	51	208
2. 320 lbs. Bone Black, 160 lbs. Muriate of Potash..........	$7.70	205	36	241
3. 200 lbs. Nitrate of Soda, 320 lbs. Bone Black, 160 lbs. Muriate of Potash..................	12.34	270	58	328
4. 20 tons Barn-yard Manure......	30.00	263	61	324

It will be seen that the addition of nitrate of soda to the bone black and potash gave an increase of 65 bushels per acre, and that the nitrate, bone black and potash, together costing $12.34, produced a little larger yield than 20 tons of manure, costing $30.00. In speaking of the results, Prof. Voorhees says:

"Another point of considerable importance, since it has reference to the salability of the potatoes, was noticed at the time of digging, viz.: That those grown with chemical manures alone were bright and smooth of skin, while at least one-third of those grown with barn-yard manure were rough and partially covered with scurf."

FERTILIZERS FOR TOBACCO.

The value of tobacco depends largely upon its quality, and as the quality depends greatly upon the amount of available plant food in the soil, the use of fertilizers often results in very large profits.

At the Kentucky experiment station in 1889 experiments were made with fertilizers on Burley tobacco. The land was "deficient in natural drainage," so that the fertilizers could hardly be expected to have their full effect. Yet, as will be seen by the following table, the profits from the use of the fertilizers were enormous:

EXPERIMENTS ON TOBACCO AT THE KENTUCKY EXPERIMENT STATION IN 1889.

FERTILIZERS PER ACRE.	YIELD OF TOBACCO PER ACRE—LBS. Bright.	Red.	Lugs.	Tips.	Trash.	Total	Value of Tobacco Per Acre.
1. No Manure........		200	360	60	540	1160	$ 67.20
2. 160 lbs Nitrate of Soda......... ...	230	450	310	90	530	1610	138.40
3. 160 lbs. Sulp. of Potash; 160 lbs. Nitrate of soda....	190	755	605	120	140	1810	190.45
4. 320 lbs. Superphosphates; 160 lbs. Sulp of Potash; 160 lbs. Nitrate of soda.	310	810	420	10	360	2000	201.20

The tobacco was assorted by an expert and prices given as follows: Bright and red, fifteen cents per pound; lugs, six cents per pound; tips, eight cents per pound; trash, two cents per pound.

One hundred and sixty pounds nitrate of soda, costing about $3.75, increased the value of the crop $71.20 per acre. The addition of 160 pounds sulphate of potash gave $52.05 more, and 320 pounds superphosphate, $11.25, making altogether $134.50 per acre more than where fertilizers were not used.

A larger application of nitrate in connection with the phosphate and potash would probably have still further increased the value of the crop.

Mr. Robert P. McAnally of Saxon, N. C., wrote us September 29th, 1892, as follows:

"Your essay on the use of nitrate of soda for manure induced me to try it on tobacco last season and it did so well that I have used five times the amount this season that I did last, and my crop at this writing is the wonder and admiration of every one that sees it, so much so that the agriculturist at our Agricultural Experiment Station has written me he will call on me next week to see my tobacco crop."

We should recommend for tobacco a mixture of 200 pounds nitrate of soda, 300 pounds superphosphate and 150

EXPERIMENTS WITH FERTILIZERS ON P

KIND OF FERTILIZER USED.	Yield per Plot Large.	Small.
1. No Manure..........	143	57
2. Bone Black (superphosphate) 16 lbs., Muriate of Potash, 8 lbs..	321	51
3. Same as above with Nitrate of Soda, 10 lbs	562	40
4. Barn-yard Manure, 1 ton.......	432	65

It will be noticed that on plot 3, where r
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pounds sulphate of potash per acre. This mixture would cost about $28.00 per ton and would contain over 6 per cent of nitrogen (equal to nearly 8 per cent. of ammonia). This is nearly twice as much nitrogen as would be obtained in a "complete fertilizer" or "special tobacco manure," costing $35.00 per ton.

NITRATE OF SODA FOR GRASS.

There are numerous cases where nitrate of soda can be used with very great advantage and profit as a top dressing for grass. Milkmen, who sell milk in our cities, know the great inconvenience and loss arising from a failure of pasture or green fodder from drouth.

Farmers who raise early lambs for the butcher can well afford to spend a little money for nitrate of soda if it will give them a good bite of grass early in the season for the ewes and lambs, and that it will certainly do.

In the United States such seasons as that of 1870 in England are the rule rather than the exception, and the following results from the use of nitrate of soda on permanent meadow at Rothamsted in the dry season of 1870 are of great interest :

		Hay per acre.
1.	No manure	644 lbs.
2.	300 lbs. sulp. potash, 100 lbs. sulp. soda, 100 lbs. sulp. magnesia, 3½ cwt. superphosphate of lime	1968 "
3.	Same mineral manures as plot 2 and 400 lbs. ammonia salts	3306 "
4.	Same mineral manures as plot 2 and 550 lbs. of nitrate of soda	6300 "

It will be seen that 550 pounds of nitrate of soda give an increase over plot 2 of 4,332 pounds of hay.

The *same amount of nitrogen*, but in the form of ammonia salts, with an equal amount of minerals, on plot 3, produced about 3,000 pounds less hay per acre than when nitrogen was applied as nitrate of soda.

In a letter written March 17th, 1890, Sir John B. Lawes says :

"At equal prices for nitrogen I certainly prefer nitrate of soda to salts of ammonia. The superiority on pasture grasses is most decided, and in dry seasons when the grass upon the ammonia plots is quite burned up there is always plenty of grass where the nitrate is used. We had a great drouth in 1870, and we had no grass anywhere except upon the nitrate plots. We found roots four feet deep from the surface, evidently following the nitrate and of course getting water from the soil."

Mr. C. L. Fuller, a large and practical farmer of Rensselaer county, N. Y., wrote us in September, 1892, as follows:

"In regard to nitrate of soda, I have used it on grass more than any other crop. It gives me large crops of hay. This year I had three acres of new seeding that I put 200 pounds per acre on and I have cut twenty-one large two-horse loads from it at two cuttings. This lot three years ago produced little but moss, and would not keep one cow through the summer. I have other land that was so nearly exhausted that it required eleven acres to produce four tons of hay of poor quality. I have succeeded in getting it seeded with the use of 400 pounds of fertilizer (phosphate and potash) and a little stable manure, and then by the use of 200 pounds nitrate of soda last spring, I cut *four tons of hay per acre* this season."

FERTILIZERS FOR GARDEN CROPS.

All experienced gardeners know that in order to raise profitable crops of early cabbage, cauliflower or beets their land must be excessively rich.

Enormous quantities of dung are applied every year. The manure used supplies nitrogen, phosphoric acid, potash and other ingredients of plant-food far in excess of the amount removed in the crop. And yet it is found necessary to furnish a heavy dressing of manure every year. If this is not done the crop is poor and unprofitable.

Gardeners who make a specialty of growing large areas of early cabbage find it almost impossible to make the land rich enough the first year. They find that the second or third crop, grown and manured every year on the same land, is better and earlier than the first crop.

An experienced American gardener recommends the

application, every year, of 75 to 80 tons
per acre for *early* cabbage and 10 tons
cabbage. Many gardeners make this dis
early and late cabbage, and yet the late
much the larger crops and remove far
from the soil than the early crops.

A market gardener near New York,
quantities of manure and was very success
open a street through his garden. Belie
be sufficiently rich to carry through a
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"The effect," says the lamented Peter
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Recent scientific discoveries furnish
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food, and the late crop, being the large
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And yet, in practice, it is found absolu
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crop. The explanation is this:

All our common agricultural and horticu
up their nitrogen in the form of nitric acid

As long as gardeners use nitrogen in th

...WITH FERTILIZERS ON TOMATOES.

...r Used ...e Acre.	Cost of Fertilizer.	Yield per Acre in Bushels.	Value of Crop.
....		613	$208.61
...Soda.......	$4.00	835	300.64
...Potash. 32...	7.20	649	252.92
...Soda, 160 lbs. ...ash, 320 lbs.	11.20	867	301.25
...Manure....	30.00	612	218.27

...ed that 160 pounds of nitrate of soda, ...e an increase in the value of the crop of ...r the unfertilized land, and $82.37 over ...tons of barn-yard manure, costing $30.00, ...l also be noticed that the addition of ...lack) and potash had little or no effect. ...ndicate that tomatoes do not require ...and potash, but that enough of these ...t-food was already in the soil. Other ...ie on poorer land showed that the ...nd potash were necessary in addition to ...produce a full crop. In writing of these ...Voorhees, who conducted them, says .

...tomatoes was very decidedly increased by the use of ...alone and together with phosphoric acid and potash.

...ood success with tomatoes fertilized in the ...: Before the plants are set out work into ...ey are to be planted a handful of a mixture ...nitrate of soda and superphosphate. Then, ...s have started to grow, scatter about a ...nful of nitrate around each plant.

...TILIZERS FOR PEACHES.

...have been conducted under the direction of ...iment Station, by Mr. Stephen C. Dayton, ...nty, N. J., with fertilizers on peaches. The

application, every year, of 75 to 80 tons of stable manure per acre for *early* cabbage and 10 tons per acre for late cabbage. Many gardeners make this distinction between early and late cabbage, and yet the late cabbage produce much the larger crops and remove far more plant-food from the soil than the early crops.

A market gardener near New York, who used large quantities of manure and was very successful, was about to open a street through his garden. Believing his land to be sufficiently rich to carry through a crop of cabbage without manure, he thought it useless to waste money by using guano on that portion on which the street was to be, but on each side he sowed guano at the rate of 1,200 pounds per acre, and planted the whole to early cabbages. "The effect," says the lamented Peter Henderson, who relates the incident, "was the most marked I ever saw. That portion on which the guano had been used sold readily at $12 per hundred, or about $1,400 per acre, but the portion from which the guano had been withheld hardly averaged $3 per hundred. The street occupied fully an acre of ground, so that my friend actually lost over $1,000 in the crop by withholding $60 for manure."

Every gardener of experience can recall similar instances.

Recent scientific discoveries furnish a satisfactory explanation of these facts, and the explanation is of great practical importance.

There is no difference between the manurial requirements of an early and a late cabbage. Both require the same food, and the late crop, being the larger, requires more rather than less food or manure per acre.

And yet, in practice, it is found absolutely necessary to use far more manure for the early crop than for the late crop. The explanation is this:

All our common agricultural and horticultural plants take up their nitrogen in the form of nitric acid or nitrate.

As long as gardeners use nitrogen in the form of barn-

yard or stable manure it is undoubtedly necessary to use this large quantity. They find it profitable to use it; but thanks to the investigations of scientific men, we now know how to obtain the same result with far greater certainty and at vastly less cost.

It is now known that the nitrogen in the organic matter of the soil or manure is slowly converted into nitric acid by the growth of a minute organism, apparently a micrococcus. This micrococcus cannot grow if the soil is too cold, or too wet, or too dry, or in the absence of lime or an alkali. As a general rule, there is no lack of lime in the soil, and the other conditions necessary for the conversion of the nitrogen into nitric acid are warm weather and a moist, porous soil.

In the early spring the soil is too wet and too cold for the change to take place. We must wait for warm weather. But the gardener does not want to wait. He makes his profits largely on his *early* crops. Guided only by experience and tradition, he fills his land with manure, and even then he gets only a moderate crop the first year. He puts on 75 tons more manure the next year, and gets a better crop. And he may continue putting on manure till the soil is as rich in nitrogen as the manure itself, and even then he must keep on manuring or he fails to get a good *early* crop. Why? The nitrogen of the soil, or of roots of plants, or dung, is retained in the soil in a comparatively inert condition. There is little or no loss. But when it is slowly converted into nitric acid during warm weather, the plants take it up and grow rapidly. Unfortunately, however, if we have no plants growing in the autumn, and there is much nitric acid left unused in the soil, the rains of winter and early spring leach out a large proportion of it and it sinks into the subsoil or underdrains.

How, then, is the market gardener to get the nitric acid absolutely necessary for the growth of his early plants?

He gets it as before stated, from a
ous use of stable manure, and eve
in sufficient quantity.

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Jersey Experiment Station for
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larger crop of early ripe fruit th
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In the experiments conducted
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County, New Jersey, in 1891,
obtained:

He gets it as before stated, from an excessive and continuous use of stable manure, and even then he *fails to get it in sufficient quantity.*

One thousand pounds of nitrate of soda will furnish more nitrogen to the plants *early in the spring* than the gardener can get from 75 or 100 tons of well-rotted stable manure. The stable manure will furnish nitric acid for his later crops, but for his early crops the gardener who fails to use nitrate of soda is blind to his own interests.

NITRATE OF SODA FOR TOMATOES.

There is an old-established idea that manure is injurious rather than beneficial to tomatoes. "Manure makes them run too much to vine," as an old gardener would say. As a matter of fact there is some truth in this idea. Ordinary farm-yard manure is found to keep the plants growing vigorously until late in the season, at the expense of the production of early fruit. This is largely due to the fact that the nitrogen in the manure is not available until it has been converted into nitric acid. Thus the tomato plants have little nitrogen to grow on early in the season, so that their growth is retarded until the supply of nitric acid is increased, when it is too late to produce a crop, and the plants "run to vines."

It has been found by experiments made at the New Jersey Experiment Station for three years, that nitrate of soda, applied when the plants are set out, greatly increased their growth early in the season and produced a much larger crop of early ripe fruit than either barn-yard manure, "phosphates," or no manure at all.

In the experiments conducted by the New Jersey Experiment Station, on the farm of Mr. J. M. Gill, Gloucester County, New Jersey, in 1891, the following results were obtained:

EXPERIMENT WITH FERTILIZERS ON TOMATOES.

	Kind of Fertilizer Used and Quantity per Acre.	Cost of Fertilizer.	Yield per Acre in Bushels.	Value of Crop.
1.	No Manure.............		613	$208.61
2.	160 lbs. Nitrate of Soda.......	$4.00	830	300.64
3.	160 lbs. Muriate of Potash, 320 lbs. Bone Black..........	7.20	649	252.92
4.	160 lbs. Nitrate of Soda, 160 lbs. Muriate of Potash, 300 lbs. Bone Black..............	11.20	867	301.25
5.	20 tons Barn-yard Manure....	30.00	612	218.27

It will be noticed that 160 pounds of nitrate of soda, costing $4.00, made an increase in the value of the crop of $92.03 per acre over the unfertilized land, and $82.37 over the land where 20 tons of barn-yard manure, costing $30.00, was used. It will also be noticed that the addition of phosphate (bone black) and potash had little or no effect. This does not indicate that tomatoes do not require phosphoric acid and potash, but that enough of these elements of plant-food was already in the soil. Other experiments made on poorer land showed that the phosphoric acid and potash were necessary in addition to nitrate of soda to produce a full crop. In writing of these experiments Prof. Voorhees, who conducted them, says .

The yield of early tomatoes was very decidedly increased by the use of nitrate of soda, both alone and together with phosphoric acid and potash.

We have had good success with tomatoes fertilized in the following manner : Before the plants are set out work into the soil where they are to be planted a handful of a mixture of equal parts of nitrate of soda and superphosphate. Then, when the plants have started to grow, scatter about a small tablespoonful of nitrate around each plant.

FERTILIZERS FOR PEACHES.

Experiments have been conducted under the direction of the N. J. Experiment Station, by Mr. Stephen C. Dayton, of Somerset county, N. J., with fertilizers on peaches. The

fertilizers and manure have been applied every year for six years, during which time the trees have borne four crops. Their first crop was in 1887. In 1888 and 1889 good crops were secured, but in 1890 the crops were a total failure, as elsewhere in the state; in 1891 there was a large crop harvested. It was found that an application of 150 pounds nitrate of soda, 350 pounds superphosphate, and 150 pounds muriate of potash produced nearly as good results as twenty two-horse loads of manure, costing nearly three times as much. In 1891 the trees that had nitrate, in addition to superphosphate and potash, yielded 161 baskets per acre *more* than where the superphosphate and potash were used alone. And where the three were used together the yield was 342 baskets per acre more than where no manure or fertilizers were used.

By the use of nitrate of soda, superphosphate and muriate of potash, an average clear net profit of over $75.00 per acre each year was secured. Where barn-yard manure was used the average yearly profit was only $44.00.

Mr. Robert B. Treat, of Centreville, Rhode Island, wrote us February 24th, 1893, as follows:

"Up to 1891 we had never received even a fair crop of peaches, but that spring I applied nitrate of soda at the rate of 250 pounds to the acre. The result was most gratifying. We raised more fruit that year than for several years previously combined. By the use of nitrate of soda our tomatoes yielded at the rate of 350 bushels per acre.'

NITRATE OF SODA ON STRAWBERRIES.

An experiment with nitrate of soda on strawberries was conducted by Mr. J. M. White, of Middlesex county, N. J., in 1891, under the direction of the N. J. Experiment Station. Phosphoric acid and potash were supplied when the plants were set out in 1889. In the spring of 1891 nitrate of soda was sown broadcast on part of the patch, at the rate of 200 pounds per acre, while the other part received no nitrate. The result was as follows:

No Nitrate	162 qts. per plot (1/8 acre).
With Nitrate	213 " " "

The gain from the use of nitrate was at the rate of 408 quarts per acre. This was due largely to the increased size of the berries. These berries sold at the average price of 10 1/3 cents per quart, so that from the use of 200 pounds nitrate of soda, costing $4.50, there was a gain of $44.32 per acre, or 10 cents for every cent invested in nitrate.

In *Orchard and Garden* for May, 1890, Professor W. W. Massey, of the N. C. Experiment Station, writes as follows:

"In the spring of 1888 I top dressed an old strawberry bed, in its fifth year of bearing, with 300 pounds of nitrate of soda per acre. I had intended to plough it up the previous summer, but other matters prevented, and the bed was in an exhausted condition and rather foul with white clover and sorrel. The effect was amazing, for this bed of an acre and a quarter, from which I expected hardly anything, gave me 7,000 quarts of berries. Variety Crescent, with fertilizing rows of Wilson, Sharpless, and others. The crop was nearly as large as the best the plot had made."

This was on moist bottom land, naturally fertile.

FERTILIZERS FOR RASPBERRIES, CURRANTS, GOOSEBERRIES, ETC.

As has been shown by the experiments on tomatoes, peaches and strawberries, enormous profits are often realized from the use of fertilizers on these fruits. The same is undoubtedly true in the case of raspberries, currants, etc., although we have unfortunately no comparative experiments with the use of fertilizers on these fruits.

We have, on our own farm, a little over three acres of red currants which have been in bearing for five or six years. In 1890 the crop was less than 6,000 pounds; in 1891 it was 8,200 pounds. In the spring of 1891 we applied a mixture of superphosphate and kainit (potash) at the rate of about 400 pounds per acre. In the spring of 1892 we applied 200 pounds superphosphate, 100 pounds muriate of

potash and 200 pounds nitrate of soda per acre. The crop of 1892 amounted to nearly 16,000 pounds, and sold for over $800, yielding a net profit of $300 more than the year before. That this great increase of yield was due to the application of the 200 pounds nitrate of soda per acre is of course not proved, but it certainly looks as though it had a good deal to do with it. The season of 1891 was a remarkably favorable one for fruit. The season of 1892 was certainly no better, and usually considered much less favorable.

We have used nitrate of soda in connection with superphosphate and potash on raspberries with equally good results. In fact, as red raspberries usually sell for twice as much per pound as currants, the profits from the use of fertilizers are often much greater.

We think it is the best plan to apply the superphosphate and potash *in the fall* and the nitrate of soda in the spring. There is no danger of losing any of the phosphoric acid or potash, as they will not leach out of the soil, and they need the heavy rains and frosts of winter to get them down to the roots of the plants. The nitrate is easily dissolved, and the first heavy rain will wash it down to the roots. If it is applied in the fall more or less will be wasted by leaching out of the soil during the winter.

NITRATE OF SODA FOR ASPARAGUS.

We have had remarkable success in raising large, early asparagus by simply sowing 500 pounds of nitrate of soda per acre early in the spring. The land is naturally rich, otherwise it would be necessary to apply superphosphate and potash as well as nitrate.

Enormous profits may be derived from the proper use of fertilizers on asparagus.

If the rent, labor, etc., for a crop of asparagus is $200 per acre, and the crop is three tons of green shoots at $100

per ton, on the farm, the profit is $100 per acre. If we get six tons at $100 per ton, the profit, less the extra cost of labor and manure, is $400 per acre.

In such crops as asparagus, however, doubling the yield by the use of nitrate of soda does not tell half the story.

Asparagus is sold by the bunch, weighing about 2½ pounds. The prices range, according to earliness and quality, from 10 cents to 25 cents per bunch at wholesale, or from $80 to $200 per ton.

By leaving out all these considerations and assuming that the non-nitrated asparagus yields three tons per acre and sells for $100 per ton, and that the nitrated asparagus yields six tons per acre and sells for $200 per ton, the profits of the two crops, less the extra cost for labor and manure are as follows:

Without Nitrate of Soda, $100 per acre.
With Nitrate of Soda, $1,000 per acre.

The safest way is to apply in the fall 400 pounds superphosphate, 150 pounds muriate of potash and 100 pounds nitrate of soda per acre, sown broadcast. Early in the spring sow broadcast 300 to 400 pounds nitrate of soda per acre.

HOW TO APPLY NITRATE OF SODA AND OTHER FERTILIZERS.

The first thing to do is to prepare the fertilizers and, if they are to be used at the same time, to mix them together.

Nitrate of Soda comes from South America in bags which weigh about 300 pounds each. It is usually sold in the original bags. The nitrate looks much like coarse salt and is often compacted into large lumps. These lumps should be broken, which can easily be done by turning the nitrate out on the barn floor and striking the lumps with the back of a spade. The nitrate should then be run through a sieve with a mesh not larger than one-fourth inch. It will then be ready for use.

Superphosphate is usually fine and dry and needs no preparation. But if there are any lumps they should be broken up.

Muriate of Potash comes from Germany in bags weighing 224 pounds each, and is much finer than nitrate. It sometimes forms in lumps, which should be broken as directed for nitrate. If the fertilizers are to be mixed together, pour the right quantity of each in a pile on the floor and turn them over two or three times with a shovel until they are thoroughly mixed. It is a good plan to run the whole through a sieve, which will mix the fertilizers better than any other way. If nitrate is used, the mixing should not be done more than a week before the fertilizers are to be used, as the nitrate will attract moisture and get hard if left too long after mixing, and there is also a loss of nitrogen when nitrate and superphosphate are mixed together for any length of time.

MODE OF APPLICATION.

We have found the following methods of applying fertilizers to the various crops to be the best and most practical. We have given directions for application to wheat, oats, barley, etc., and refer below to the pages on which these directions may be found:

Wheat—See page 10.

Barley—See page 13.

Oats—See page 14.

Grass for Pasture or Hay.—The best way is to sow broadcast *in the fall* a mixture of say 250 lbs. superphosphate and 50 lbs. muriate of potash per acre, and early in the spring sow broadcast 150 to 200 lbs. nitrate of soda per acre. Or all three may be mixed together and sown early in the spring. The latter method is usually followed.

Potatoes—If in rows marked only one way, scatter a mixture of, say 200 pounds nitrate, 350 pounds superphosphate and 100 pounds muriate of potash along the rows, a hand-

ful to every step. If you step three feet, this will put on about 600 pounds per acre; if only two feet, 900 pounds per acre. Run a fine tooth cultivator along the rows to mix the fertilizers with the soil. It will of course be necessary to mark out the rows again before planting the potatoes. If planted in hills marked both ways, drop a handful on each hill and mix well with a hoe or potato hook; but this is not as satisfactory as the other method.

Sweet Potatoes—See page 16.

Tobacco—See page 17.

Tomatoes—See page 23.

Corn—Apply the same mixture as recommended for potatoes and in the same way. It usually will not pay to use more than one ounce (about one-half handful) to a hill.

Cabbage and Cauliflower—For growing the plants, sow broadcast the same mixture as recommended for potatoes, using a small handful to each square yard of ground, and rake or harrow it in before sowing the seed.

For early cabbage, set close together, it will pay to sow the fertilizers broadcast over the whole ground and work them in before setting out the plants. If the land has been heavily manured for a number of years, nitrate of soda alone may do as much good as the mixture. In this case, the nitrate may be applied after the plants are set out—a teaspoonful to a plant.

For late cabbage, set two and one-half to three feet apart each way, it is a good plan to apply the fertilizers after the plants are set out. To do this, scatter a small handful of the mixture recommended for potatoes near each plant, but not on the plant. Cultivate this in with a small tooth cultivator. It is best to go twice on each row, dropping the fertilizer on both sides of the plants, using half the quantity on each side.

Celery—Superphosphate should be worked into the land intended for growing celery plants either the fall before or in the spring before the seed is sown, at the rate of 500

een applied in the fall, sow in the spring at the same the nitrate is sown and cultivate it in early in the ing.

Lawns—Sow broadcast, early in the spring, a mixture of 100 pounds superphosphate, 100 pounds nitrate of soda and 25 pounds muriate of potash using a small handful (about 1½ ounces) to each square yard of ground. It is well to ascertain how many square yards of lawn you have, then weigh out the required amount of fertilizer and keep sowing it until you have it all on. These fertilizers are perfectly odorless, and will add greatly to the luxuriance and color of the grass; they will also enable it to withstand very dry weather without becoming brown.

Roses and other Shrubs—Apply fertilizers as recommended for Raspberries.

HOW AND WHERE TO BUY FERTILIZING MATERIALS.

Since nitrate of soda and muriate of potash are brought to this country by sea, and as phosphate is usually transported from the mines in vessels, these materials, as a rule, can be purchased at the seaports cheaper than in the interior. New York is the largest market for these materials, but Boston, Philadelphia and Baltimore also receive very large quantities.

Lower prices can be obtained by ordering fertilizing materials in car-load lots. A car-load is not less than ten tons. If you cannot use a car-load yourself, get your neighbors to join with you. From $2.00 to $4.00 per ton can often be saved in this way.

In buying superphosphate always consider the percentage of *available phosphoric acid.* You should not pay more than 7 cents per pound for the phosphoric acid. That is, if the superphosphate analyzes 14 per cent. of available phosphoric acid, a ton would contain 280 lbs., and should not cost more than $19.60 per ton.

pounds per acre. As soon as the plants come u[p]
broadcast 500 pounds nitrate of soda per acre, or a
handful to each square yard. If heavy rains occur, it is
to give the plants another application of nitrate. T
need not be as heavy as the first application.

For Garden Crops, such as beets, carrots, parsnips, onions spinach, lettuce, etc., sow the mixture as recommended for potatoes, broadcast before the seed is sown, at the rate of from 500 to 1,000 pounds per acre, according to the richness of the land. When the land has been heavily manured for a number of years, it may not be necessary to use so much superphosphate and potash; in fact, potash would probably not be needed at all. Nitrate of soda alone on such land often has a wonderful effect.

Strawberries—In setting out a new bed, scatter along the rows and cultivate in, before the plants are set out, the same mixture as for potatoes. It is well to scatter the fertilizers for a foot each side of the rows so that the runners will have something to feed upon. In the spring sow nitrate of soda on the bed broadcast at the rate of about 200 pounds per acre. On old beds sow the mixture broadcast *in the fall* and an additional 200 pounds of nitrate per acre in the spring.

Raspberries, Currants, etc.—Sow broadcast, in the fall, a mixture of, say 350 pounds of superphosphate and 100 pounds muriate of potash per acre. This can be done, if the rows are six feet apart, by sowing a large handful at every two steps *on each side of the row*. Raspberries should have a small handful and currants a large handful to each bush. This should be cultivated in, if possible, early in the spring; sow nitrate of soda in the same way. It will pay to put on as much nitrate as you did superphosphate and potash; but if you do not want to put on so much, use smaller handfuls. If the superphosphate and potash have

Mr. S. M. Harris (P. O. address Moreton Farm, Monroe Co., N. Y.,) will be pleased to hear from all who are interested in this subject, and will be glad to give any further information in regard to it that may be desired.